Physical activity and obesity: is there a difference in association between the Asian- and African- Surinamese adult population?

Running head: Physical activity and obesity: ethnic differences?

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Abstract

Objective: The role of different physical activity (PA) characteristics, i.e. domain, duration and intensity in obesity prevention still requires investigation. Furthermore, ethnicity can modify the effect of PA on body composition. Therefore, we aim to describe the association between obesity and PA characteristics across the Asian- and African-Surinamese population, living in the capital of Suriname.

Design: Between February 2013 and July 2015, we included 1157 healthy subjects, 18 —70 years, from the Healthy Life in Suriname (HELISUR) study. We measured height, weight, hip and waist circumference and defined general and central obesity according to World Health Organization (WHO) recommendations. The International Physical Activity Questionnaire was used to assess PA and to calculate the duration (minutes/week) and the total volume (METs-minutes/week) of activity. Ethnicity was self-reported.

Results: Out of 1157 participants we included 1079 (42.6% Asian-Surinamese, 40.1% African-Surinamese and 17.3% of other ethnicity), mean age 42.6 ± 13.6 years for analysis. Obesity prevalence ratio (PR) was significantly lower in participants meeting WHO PA recommendations [PR= 0.81 (0.68—0.97)], especially within the commuting [PR= 0.66 (0.47—0.91)] and leisure time domains [PR= 0.67(0.47—0.94)] compared to participants that did not meet the recommendations. Active minutes/week and total volume of activity were inversely associated with obesity and waist circumference, in the overall ($p < 0.05$) and in the African-Surinamese population ($p < 0.05$), but not in the Asian-Surinamese population.

Conclusion: Meeting PA recommendations, particularly within the commuting and leisure time domains, is associated with lower obesity prevalence in the total population. Among the African-Surinamese population, PA within the leisure time domain, more active minutes/week and

higher levels of total volume are associated with a lower obesity prevalence. This is not found in the Asian-Surinamese population.

Keywords: Physical activity; Ethnicity; Asian descendants; African descendants; Body composition; Health behavior;

Introduction

Over one third of the world's adult population is overweight and at least 13% is obese [1]. Unfortunately, these numbers are increasing worldwide and at a faster rate in low- and middle-income countries, particularly in urban settings [2]. Besides being the fifth leading cause of death [3], obesity is an important cardiovascular risk factor and has also many adverse effects on other cardiovascular risk factors, including diabetes mellitus type 2, hypertension, and dyslipidemia [4, 5]. Therefore, there is an urgent need for effective treatment strategies.

Physical activity (PA) is a key element in the management of obesity [6] and the American College of Sports Medicine recommends individuals to accumulate at least 150 to 250 minutes of moderate to vigorous PA per week with a targeted energy expenditure of 400 kcal per day [7]. However, uncertainties remain with regard to the importance of each of the different PA characteristics [8-12], i.e. domain, duration or intensity, that determines optimal weight control [13-16]. Furthermore, these guidelines are based on data derived mainly from Caucasian populations, even though there is clear evidence that variations exist in body composition and cardiovascular risk factors between other ethnicities and Caucasians [17-20]. Moreover, small studies suggest that the responses to PA interventions might be different across ethnic groups [21, 22], underlining the need for ethnic-specific PA recommendations for weight management.

Suriname is a middle-income country in the north-eastern part of South America, but culturally and economically has more similarities with the Caribbean. Due to historical migrations, the population of Suriname consists predominantly of people from Asian and African descent. This provides a unique opportunity to compare ethnic differences between these groups living within the same area. As such, the Healthy Life in SURiname (HELISUR) study was designed to describe the prevalence of cardiovascular risk factors, intermediate endpoints, and

cardiovascular diseases among the different ethnic groups living within the capital Paramaribo [23]. The current report uses data from the HELISUR project to describe the association between obesity prevalence and PA characteristics (domain, duration and intensity) among the total population and across the Asian- and African-Surinamese population living in Paramaribo.

Methods

Study population

A detailed description of the HELISUR study design and participant recruitment has been published previously [23]. In short, between February 2013 and July 2015 a total of 1800 randomly selected non-institutionalized individuals (18 to 70 years) living in the capital Paramaribo were contacted and interviewed at home by trained interviewers. From the recruited participants, 1157 subjects were further examined at the academic hospital in Paramaribo. Ethical clearance was obtained from the Ethics Committee of the Ministry of Health in Suriname (Approval nr. VG021-2012) and written informed consent was provided by all participants.

Ethnicity

Participants were mainly Asian-Surinamese (self-identified South Asian and Indonesian descent); African-Surinamese (self-identified Creoles, that lived in Paramaribo for several generations and Maroons, that migrated from the rural interior area to Paramaribo in the past 10-20 years) or other ethnicity (Chinese, Amerindians and Caucasians). In the current report we focused on the Asian and the African-Surinamese group, comprising the four main ethnic groups living in Paramaribo.

Assessment of PA

The Dutch version of the International Physical Activity Questionnaire-long form (IPAQ-LF) was used to assess PA. This version has been validated previously [24] and was pre-tested for reliability and face-validity in a small study sample. Participants were asked about their activities within the 1) working, 2) commuting, 3) domestic and garden, and 4) leisure time domain during the last seven days. Activities that were performed as part of paid or unpaid work were classified as activities within the working domain, whereas cycling and/or walking from one place to another were defined as activities within the commuting domain. Chores within and around the house were classified as activities within the domestic and garden domain whereas walking activities and/or activities that were not included within the former domains were classified within the leisure time domain. Within every domain the subjects were asked about the number of days and the amount of time they spend doing these activities and at what intensity. Activities could be performed at moderate or vigorous intensity or at a walking level. Moderate intensity was defined as experiencing a slight increase in heartrate and breathing rate, whereas vigorous intensity was defined as experiencing a significant increase in heartrate and breathing rate. Furthermore, an activity within each domain and intensity had to be performed for at least 10 minutes continuously to be considered valid.

The “Guidelines for data processing and analysis of the IPAQ: short and long form” [25] were used to clean and analyze the data. These guidelines provide information on how to calculate the duration of activity per week (minutes/week) for the domains separately and combined. This is done by multiplying the number of days by the amount of time spend per day being active for each domain and combined. Also, the PA volume was calculated for each participant by multiplying the duration by the assigned metabolic equivalent (MET) value for a specific activity

within each domain (METs-minutes/week). The guidelines provide these MET values for the intensity of each activity, ranging from 3.0 to 8.0 METs. The total volume of PA is then calculated by combining the calculation of all the domains. Subsequently, participants who met at least one of the following recommendations were categorized as meeting the recommended level of PA that corresponds to the WHO guidelines for PA:

1. Physical activity on at least 3 days of the week at a vigorous intensity for at least 20 minutes/day
2. Physical activity on at least 5 days of the week at moderate intensity or walking for at least 30 minutes/day
3. Physical activity on at least 5 days of the week of any combination of walking, moderate or vigorous intensity activities with a minimum of 600 MET-minutes/week
4. Physical activity on at least 3 days of the week at a vigorous intensity achieving a minimum of at least 1500 MET-minutes/week
5. Physical activity of any combination of walking, moderate or vigorous intensity activity with a minimum of 3000 MET-minutes/week

Assessment of body composition

During the hospital visit, data on body composition were assessed by a single investigator [23]. Waist circumference (WC) was measured at the midpoint between the lower margin of the least palpable rib and the top of the iliac crest, whereas the hip circumference was measured at the broadest circumference below the waist, using a stretch resistant measuring tape. In order to calculate the body mass index (BMI: kg/m²), height and weight were measured using a stadiometer (SECA) and a scale (SECA 840), respectively. All four measurements were done in duplicate and a third measurement was made if the difference between the first two readings was

>1.0 cm for the circumferences, >0.5 cm for height and >0.5 kg for weight. Mean values were used in the analysis. For the definition of overweight and obesity, we used the ethnic-specific BMI cut-off values that correspond to a high risk for undesirable health proposed by the WHO. For the African-Surinamese and other ethnicities overweight was defined as $\text{BMI} \geq 25 \text{ kg/m}^2$ and obesity as $\text{BMI} \geq 30 \text{ kg/m}^2$, whereas for the Asian-Surinamese overweight was defined as $\text{BMI} \geq 23 \text{ kg/m}^2$ and obesity as $\text{BMI} \geq 27.5 \text{ kg/m}^2$ [26, 27]. Central obesity was defined using the ethnic-specific criteria of the International Diabetes Federation [27, 28]. For the Asian-Surinamese participants, the cut-off values of $\geq 90 \text{ cm}$ for men and $\geq 80 \text{ cm}$ for women were used and for the African-Surinamese and other ethnicity participants the cut-off values of $\geq 94 \text{ cm}$ for men and $\geq 80 \text{ cm}$ for women were used [27, 28].

Statistical analysis

Statistical analysis was performed using SPSS (version 21, SPSS Inc., Chicago, IL). Sensitivity analysis was done to compare the participants that were interviewed with the participants that were interviewed and completed the physical examination. Furthermore, analyses were made for the total population and for each of the two main ethnic groups: Asian-Surinamese and African-Surinamese. Continuous variables were tested for normality by visual inspection of the histogram. Descriptive data were reported as means $\pm$ standard deviations, medians (range), or percentages; differences between both ethnic groups were tested with an ANOVA or chi-square test. For the total PA and for the separate characteristics (i.e. domain, duration and intensity), the percentage of participants meeting the recommended PA level were calculated for the total population and for each ethnic group.

In order to compare the obesity prevalence in participants meeting the recommended PA level and those not meeting the recommended level, we estimated prevalence ratios (PR) with corresponding 95% confidence intervals (95%CI) using Poisson regression models with robust variance [29] and adjusted for sex and age.

The continuous variables duration (minutes/week), mean intensity (METs) and volume (METs-minutes/week) were categorized into tertiles. For the total population and for each ethnic group, the obesity PR (95% CI) within each tertile was calculated using the lowest tertile as the reference group. For BMI and WC, the mean values within each tertile of the duration, intensity and total volume were compared. This was done for the total population and for each ethnic group using an ANOVA test with the significance level set at a two-tailed p-value <0.05.

Results

From the 1157 participants that underwent physical examination, 78 were excluded for the final analysis, either because of missing (n=19) or invalid PA data (n=7), a history of coronary heart disease (n=22) or stroke (n=30), resulting in a sample of 1079 participants [42.6% Asian-Surinamese (n=460), 40.1% African-Surinamese (n=432) and 17.3% other ethnicity (n=187)]. The other ethnicity group included mainly participants of mixed ethnicity (n=164), but also a small number of Amerindians (n=13), Chinese-Surinamese (n=2), and people of other descent (n=8) (Figure 1).

Table 1 shows the characteristics of the total study population and the two ethnic groups. The majority of the population was female (63.9%) with an equal distribution between both ethnic groups (p=0.52). BMI was significantly higher in individuals of African-Surinamese origin (p<0.01). However, based on the current definitions for overweight and central obesity, both

were significantly more prevalent among the Asian-Surinamese population (both $p < 0.01$) whereas there was no difference with regard to the prevalence of obesity across both ethnic groups ($p = 0.81$). Overall, 78.5% of the participants met the PA recommendations, with the Asian-Surinamese being slightly more active compared to African Surinamese (82.2% in Asian-Surinamese vs. 76.6% in African-Surinamese, $p < 0.05$).

For the total sample, the age and sex-adjusted prevalence of obesity was 19% lower in participants who met the recommendations for PA (PR=0.81 [95% CI 0.68—0.91]), as depicted in Table 2. Focusing on each of the domains of PA, the prevalence of obesity was 33-34% lower in participants who met the recommended level of PA within the commuting or leisure time domain [for the commuting domain: PR=0.66 (95% CI 0.47—0.91); for the leisure time domain: PR=0.67 (95% CI 0.47—0.94)]. For the work and domestic and garden domain we did not find a significant association. Regarding the ethnic subgroup analysis, obesity was significantly less prevalent among African-Surinamese individuals meeting the PA recommendations within the leisure time domain [PR=0.43 (0.20—0.91)] compared to those that did not. This association could not be observed in the Asian-Surinamese population [PR=0.78 (0.49—1.24)]. For the three remaining domains, we did not find a significant association in both the Asian- and the African-Surinamese population.

As shown in Table 3, obesity was less prevalent in the overall sample among the participants being active for at least 1141 minutes/week [PR=0.79 (0.66—0.94)] or performing more than 5281 METs-minutes/week [PR=0.79 (0.66—0.95)]. Similar results could be observed for the subgroup of individuals from African-Surinamese origin, but not in the Asian-Surinamese individuals. No association between PA intensity and obesity prevalence could be established for the total population and for both ethnic groups.

Finally, as shown in Table 4, the mean BMI and WC decreased with increasing duration, intensity and volume for the overall population. For the African-Surinamese population both the BMI and WC decreased with increasing duration, intensity and volume, whereas for the Asian-Surinamese population only the intensity within the highest tertile significantly lowered the BMI, but not the WC, compared to the other tertiles.

As shown in figure 1, from the 1800 recruited and interviewed participants, 1157 completed the physical examination. Sensitivity analysis showed that there were no differences between participants who were only interviewed and participants who were interviewed and completed the physical examination in sex, prevalence of smoking and meeting the WHO recommendations for PA (78.5% vs 81.4%, $p>0.05$). However, participants who were also physically examined were significantly older (42.6 ± 13.6 vs 35.5 ± 14.0 , $p<0.05$) more often African-Surinamese (51.4% vs 40.1%], $p<0.05$) and less often Asian-Surinamese (31.4% vs 42.6% , $p<0.05$).

Discussion

The results of this substudy of the HELISUR project show that 1) overweight and central obesity are more prevalent among the Asian-Surinamese compared to the African-Surinamese population living in urban Paramaribo; 2) obesity prevalence is similar in both ethnic groups; 3) meeting the PA recommendations and being active within the commuting and leisure time domain are all inversely associated with obesity prevalence in the total population; 4) prevalence ratios for obesity are lower in individuals spending more time to PA and performing larger volumes both in the total population as well as within the African-Surinamese population; 5) no

association could be established between PA and obesity prevalence in individuals of Asian origin; 6) body mass index and waist circumference were significantly lower with increasing duration, intensities and volume in the total population and in the African-Surinamese population; 7) only BMI was significantly lower in the Asian–Surinamese population in the highest tertile of intensity.

The results of our study are in line with previous studies showing that meeting the weekly recommended amount of PA, as formulated by the WHO, is inversely associated with obesity [30, 31]. This was especially true for being active within the commuting and leisure time domain [9, 12]. However, we could not establish such association for work-related and domestic and garden activities. There are likely various reasons for these different associations across the PA domains and obesity. First, we used self-reported PA data, which is sensitive to social desirability bias, recall bias, and overestimation [32-34]. Foong et al [35] also reported that the adiposity and PA association was stronger for accelerometer-determined PA than questionnaire-determined PA. Therefore, an overestimation could have masked an existing association among the working and domestic and garden domain. For these two domains in particular, subjects find it very difficult to define the exact amount of time and the intensity of the activities [32, 33]. Commuting and leisure time activities are more planned activities allowing the participants to estimate the time and intensity spend in these domains more accurately [34].

We also found a lower prevalence ratio of obesity among individuals of African origin meeting the recommended levels of PA in their leisure time, but not in individuals of Asian origin. Also, more time spend to PA and higher volumes were associated with lower prevalence ratio's in the African-Surinamese but not in the Asian-Surinamese population. These results are in line with Kwon, Wang and Hawkins (2013) who reported an inverse relation between leisure time PA and

obesity among the African but not among the Asian population[36]. The reason for this finding remains unclear and warrants further research. The use of categorical data leading to statistical power loss might be one of the reasons. However, we hypothesize that the Asian-Surinamese population is more sensitive for social desirable reporting [37], leading to over reporting of PA compared to individuals of African origin. To this end, the use of more objective instruments to quantify PA is necessary.

Among the African-Surinamese population the BMI and WC were consistently lower in the highest tertiles for duration, intensity and volume. Among the Asian-Surinamese only the BMI was significantly lower in the highest intensity tertile compared to the lowest tertile. Even though Lesser et al.(2012) did report that visceral adipose tissue was inversely associated to vigorous intensity PA among Asians[38], we did not find a lower WC for the highest intensity tertile compared to the lowest tertile. This significant lower BMI without the consistent lower WC among the Asian-Surinamese population points out that the adipose tissue might be less in other body areas except the abdominal area or they even have lower muscle mass. In order to accurately assess adiposity, its regional distribution and also lean mass, dual x-ray absorptiometry (DXA) would be a valid measuring tool [39]. Unfortunately, we were limited to the use of BMI calculations and WC measurements to define obesity and central obesity using the WHO recommended ethnic specific cut-off values (WHO 2004). However, these cut-off values have not been validated within our population.

The differences in association between body composition and PA between the Asian and African-Surinamese population could be caused by a difference in fat oxidation between ethnic groups. Compared to Caucasians, Asians have a lower level of fat oxidation at the same level of activity, whereas Africans show the same fat oxidation [20, 40]. Furthermore, compared to

Caucasians, Asians need to engage in higher levels of PA for the same cardiovascular and metabolic profile [22, 41]. Therefore, Asians might benefit from exercise at higher intensity to affect visceral adipose tissue.

Unfortunately, insufficient dietary information precluded us from taking nutrition into account. Nutrition is at least as important in weight management [42-44]. Previous studies have reported differences in dietary patterns between Asians, Africans, and Caucasians. Compared to the Caucasians, Asians had a higher energy intake, whereas Africans had similar energy intakes [45]. South Asians also have a higher intake of staple food including rice, fried rice and noodles compared to Caucasians [46]. The possible variety in diet between the Asian- and African-Surinamese population is definitively something which needs to be taken into consideration in future research.

Furthermore, because of the cross-sectional design, these findings are merely demonstrating associations and not necessarily prove causality. In this regard, it could be that obese participants tend to be less physically active within their leisure time and are more likely to use the car/bus for commuting to and from work, explaining the higher prevalence of obesity in individuals who were not physically active in the leisure time or commuting domain.

Finally, the combination of the four major ethnic groups, the South Asian, the Javanese, the Creole and Maroon population within respectively, the Asian- and African-Surinamese population could also be a limitation. Due to the small number of participants within each major ethnic group we decided to make these two combinations based on the region of origin. However, we acknowledge that these groups have a different cultural and genetic background that could influence the differences in association between PA characteristics and body composition. For the definition of overweight, obesity and central obesity we used BMI and WC

cut-off values that need further validation in our population. Therefore, future studies focusing on the ethnic differences should include sufficient number of participants of each group separately.

To conclude, our results show that meeting PA recommendations, especially within the commuting and leisure time domain, are associated with reduced levels of obesity in the total population. Furthermore, in the African-Surinamese population spending more time physically active and PA within the leisure time are associated with less obesity, whereas such an association could not be observed among the Asian-Surinamese population. Our results therefore underline the targets of the WHO to increase PA in prevention of obesity [47] and emphasize the need for more in depth research into the role of PA characteristics using more objective tools in combatting the obesity epidemic in general and in different ethnic groups.

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Authors contribution

LB and GO conceived the study and wrote the protocol. GO sought ethical approval. SB and FD analysed the data. SB, FD, VC and JT drafted the manuscript. All authors read, edited draft versions and approved the final manuscript.

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Figure 1: Flowchart

Legend: Sampling scheme of the population. Participants from other ethnicity were included in the total population analysis.